CONTRACT TITLE: Enhanced Oil Recovery - EM Field Test at BP Well Site

DATE REVIEWED: 07/19/91   **DATE REVISED:** 07/16/91

OBJECTIVE: To perform a field test for applying cross-borehole electromagnetic imaging at the BP Devine Texas test site. The purpose is to establish the precision level of instrumentation in an oil field environment and to image the layered section using tomographic inversion codes.

CONTRACT NO: 　FEW 6039 **B & R CODE:** AC1505100	**CONTRACTOR:** 　Lawrence Livermore 　Laboratory **ADDR:** P.O. Box 808 　Livermore　　　CA 94550
CONTRACT PERFORMANCE PERIOD: 10/01/89　to 09/30/91 **PROGRAM:** **RESEARCH AREA:**	**CONTRACT PROJECT MANAGER:** **NAME:** Mike Wilt **ADDR:** Lawrence Livermore Lab 　P.O. Box 808, L-228
DOE PROGRAM MANAGER: **NAME:** Ralph Avellant **FTS PHONE NO:** 233-2737 **COMMERCIAL NO:** (301)353-2737	Livermore　　　CA 94550 **PHONE:** (415)422-3152
DOE PROJECT MANAGER **NAME:** Reid, Thomas B. **LOCATION:** BPO **FTS PHONE NO:** 745-4233 **COMMERCIAL NO:** (918)337-4233	**PROJECT SITE** 　Livermore, CA

SCHEDULE MILESTONES:

Prepare instrumentation to collect cross-borehole electro-
magnetic data at well depths to 1000 meters.   04/90
Collect baseline EM cross-well data at site.   08/90
Reduce data and interpret results.   11/90
Report field results.   12/90

CONTR. FUNDING	FUNDING (1000'S)	DOE	OTHER	CONTRACTOR	TOTAL
	PRIOR FISCAL YRS	88.0	0.0	0.0	88.0
	FISCAL YR 1991	0.0	0.0	0.0	0.0
	FUTURE FUNDS	0.0	0.0	0.0	0.0
	TOTAL EST'D FUNDS	88.0	0.0	0.0	88.0

PROJECT DESCRIPTION: To perform a field test for applying cross-borehole and surface-to-bore-hole electromagnetic imaging at the BP/SOHIO test facility in Devine, Texas. The purpose of the test is to establish the precision level of the system in an oil field environment and to image the layered section using tomographic inversion codes.

The field testing is being done in cooperation with Lawrence Berkeley Laboratory and a consortium of Petroleum and Service Companies who are supporting research in cross-borehole EM.

PRESENT STATUS: The project has been completed.

ACCOMPLISHMENTS: The instrumentation was prepared and extensively tested at the U.C. Richmond field station test facility. The requirement for imaging is that collected data be repeatable over time to better than one percent. This requirement meant that the system had to undergo significant modification to make it insensitive to variations in temperature, moisture and external noise.

The extensive testing at Richmond field station produced an accurate, reliable system that can confidently be taken to the field. The data set collected in Devine allowed the testing of the sensitivity of the method to small variations in resistivity and to test the recently developed modeling alogrithms on a real data set.

The field test was made during the period of September 10-22. During the test, cross-hole data sets were collected at numerous levels and at several frequencies. Also, data was collected through steel-cased sections of the well to test sensitivity of the method through casing. Preliminary results show that the quality of the data set is exceptionally good.

BACKGROUND: Lawrence Livermore National Laboratories has pioneered the theory, development and application of high frequency EM topography for over 20 years. During this time, the technique has been successfully applied to the problems of tunnel detection, firefront monitoring and coal gasification and to a lesser extent, steam-front monitoring. Due to the high electrical conductivity of most oil reservoirs and the 20-300m well spacing, the high frequency techniques has not been proven effective for EOR monitoring. During the past several years, however, research at LLNL and LBL into the lower frequency cross-borehole induction tomography has shown that it has excellent promise for underground imaging. The technique is effective at well-spacings up to 200m in oil field environment and may even be applied in steel-cased boreholes. The induction system, which operates in the frequency band of 100-20,000hz, is capable of providing an accurate but diffuse image of a steam front.